



Auditory Short-Term Memory in L2 Listening Comprehension Processes

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Abstract

This paper discusses some of the general issues that involve the relationship between memory and L2 comprehension by focusing on the roles of auditory short-term memory (STM) in L2 listening processes. Specific research questions to be addressed here are: 1) What processes are involved in L2 listening comprehension?, 2) What roles does memory play in L1 and L2 listening comprehension processes?, and 3) What are the relationships between short-term memory (STM) and L2 learning? While examining the specific processes involved in L2 listening comprehension processes, this study argues that L2 listening comprehension is initially constrained by the limited capacity of auditory STM available, but its development can be enhanced through L2 syntactic exercises that focus on the structures. The teacher's awareness of the role that memory plays in L2 listening comprehension processes, thus, seems to be quite important in providing more effective teaching activities in the classroom.

Introduction

As my experience as a L2 learner certainly tells, many kinds of cognitive tasks in the L2, such as remembering numbers or dates in listening comprehension or doing some mathematical problems, seem to require more mental energy and time than in the L1 (Magiste, 1979; Marsh & Maki, 1978). According to Cook (1991, p. 71), L2 learners have a sort of "cognitive deficit", in the sense that their mental processes work less efficiently in the L2 than in the L1. In other words, the memory span of L2 learners might be more restricted in the L2 than in the L1 (Brown & Hulme, 1992; Glicksberg, 1963).

Although it is quite debatable whether L2 learners will remain cognitively restricted even as their L2 proficiency develops, there are some pieces of evidence that show that their mental processing is at least initially limited in capacity in many of the L2 tasks that they encounter along their learning processes (Cook, 1977, 1979; Papagno & Vallar, 1992; Service, 1992).

For example, when L2 learners tackle the reading task, they can take a relatively long time to go over each word or phrase as many times as they want or go back to

the first parts of the written text which may have been forgotten while reading the last parts, so that they can comprehend the whole sentence or text. But in listening comprehension tasks, where words and phrases are chopped off in a fleeting second, they cannot look back at the beginning of each word or sentence that they have failed to understand (Call, 1985; Joiner, 1986).

Especially when utterances are made quite fast, the processing load for L2 learners might naturally be increased, making it more difficult for the learners to comprehend the meaning of the utterances. As Rivers and Temperley (1978) point out, L2 short-term memory is often overloaded, causing words to be purged before they can be organized in L2 patterns and then interpreted. This kind of listening failure is often expressed by many L2 learners in the form of sheer frustration; that is, for instance, even though they can recognize each word of a sentence as it is spoken, they may not be able to retain all pieces of information long enough to interpret them (Joiner, 1986). Thus, it seems reasonable to argue that memory can play a significant role in L2 listening comprehension processes.

Indeed we intuitively know that a good memory serves as one of the most important indicators of learning success and high performance, whether in L1 or L2, but the relationship between memory and general learning abilities cannot readily be transferred to the explanation of L2 learning success or failure. At the same time, however, the general assumption that workings of memory and cognitive processing have an interconnected relationship with each other, cannot be easily dismissed either, especially in the contexts of L2 learning and teaching, where a lot of cognitively complex activities or learning tasks are involved (Scovel, 2001; Skehan, 1998).

Thus, in this paper, I would like to address some of the general issues which involve the relationship between memory and L2 comprehension by focusing on the roles of auditory short term memory (STM) in L2 listening processes. General questions to be dealt with here are:

- 1) What processes are involved in L2 listening comprehension?
- 2) What roles does memory play in L1 and L2 listening comprehension processes?
- 3) What are the relationships between short-term memory (STM) and L2 learning?

Based on such discussions, some implications for L2 teaching can be drawn, especially as to how teachers can make the L2 listening comprehension tasks more manageable and effective to the students.

What processes are involved in L2 listening comprehension?

Although many practical guides to the teaching of L2 listening skills have been available, it is not until recently that there has been much research specifically concerned with the process of L2 listening comprehension. This neglect may have been attributable to the traditional belief or assumption held by both teachers and researchers that listening is a passive skill and that mere exposure to the spoken language would be enough for students to develop their listening skills automatically (Scarcella & Oxford, 1992).

In the field of psycholinguistics, however, the ability to comprehend a spoken language is widely recognized as a rather complex and active skill that involves many different mental processes (Taylor, 1981). According to Byrnes (1984, p. 318), listening comprehension can be regarded as a “highly-complex problem-solving activity” that is comprised of a set of distinct sub-skills.

Those sub-skills are roughly categorized into the following two parts (Rivers, 1971): 1) the recognition of component parts of the language (i.e., words, verb groups, or simple phrases) and 2) memory for these linguistic elements upon the time when they have been recognized (Call, 1985). Although recognition of each linguistic element is essential to the process of listening comprehension, it does not necessarily guarantee the comprehension of what is heard, because the utterance which contains a lot of linguistic information needs to be retained in the listener's short-term memory for a while, so that the utterance can be processed for further semantic interpretation.

In addition, the series of processes through which the sounds associated with a particular utterance are converted into meaning involve the two types of parsing mechanisms, that is "bottom-up" or "top-down" parsing processes (O'Malley, Chamot, & Kupper, 1989).

"Bottom-up" processing refers to the process in which the listener makes sense of an utterance bit-by-bit, starting from the smallest parts (i.e., the sounds → words → phrases → a whole sentence).

"Top-down" processing, on the other hand, means that the listener tries to understand an utterance by analyzing the language data in a holistic manner, starting from a whole sentence and breaking it down into the smaller parts.

In principle, the mind could utilize either the bottom-up or top-down parsing processes for language comprehension, but in practice listeners seem to make use of both types of parsing processes for further enhancement of their listening comprehension (Cook, 1991; O'Malley et al., 1989).

What roles does memory play in L1 and L2 listening comprehension processes?

As examined in the previous section, the listeners rely on previously acquired knowledge or experience (top-down processing) as well as present acoustic stimuli (bottom-up processing) in interpreting the speech signals they are listening to. It should be noted, however, that such process of decoding the incoming linguistic stimuli is in progress when the listeners also need to retain the perceived linguistic elements in mind, in order to actually interpret them for getting a particular meaning or meanings. This is where the issue of memory comes in.

According to Loftus and Loftus (1976), the sounds are first perceived and retained in a sensory store called "echoic memory" for a very brief period of time (about one second), where the stream of physical sounds are segmented into particular linguistic units (phonetically, and morphologically) by using previously learned or acquired patterns as a guide to this task.

Upon recognition of particular patterns in the incoming sound stream, the linguistic data pass into what is called "short-term memory" storage, usually in the form of words (Call, 1985).

In reference to memory research, in which many different models of memory storage have been proposed, there are still a lot of debates over the distinction between short-term memory and long-term memory, especially as to whether the two constructs can be viewed as separate systems or separate stores (Shiffrini, 1993), or whether they have separate storage functions within a single interconnected (unitary) system (Baddeley and Hitch, 1993; Carlson, Khoo, Yaure, and Schneider, 1990).

However, most of the models have shared the following basic assumptions on the nature of short-term memory storage; 1) it involves temporary activation of neural structures; 2) it is the site of control processes such as directing focal and peripheral attention, rehearsing current information, and coding new inputs; and 3) it is limited in capacity (Robinson, 1995, p. 304).

In line with these characteristics of short-term memory, Cowan (1993, p. 66) describes its function as “the interface between everything we know and everything we can see or do”. Other researchers such as Anderson (1983) and Baddeley (1986) also conceive it as the workplace where knowledge is encoded and retrieved from long-term memory so that skill development can be initiated smoothly.

Although these functions of short-term memory are undoubtedly crucial elements for our listening comprehension, the single most salient feature of short-term memory seems to be its temporality and limited capacity, as it bears a direct impact on the process of listening comprehension.

According to several experiments conducted by Miller (1956), the capacity of short-term memory is limited to about seven units, plus or minus two. Each unit can be defined differently, depending on the types of input and also whether the listener has any previous knowledge on the particular type of input or not. Call (1985, p. 767) offers an illustrative example that shows variable nature of each unit as follows:

“[I]f a series of letters of the Roman alphabet were presented in random order to native speakers of English, they would be able to recall only about seven, plus or minus two letters. If, on the other hand, the letters were presented so that they could be patterned into English words, listeners would probably be able to recall many more letters. They would be able to group the letters into meaningful units according to their previous knowledge of English sound-symbol correspondence.”

This definition of each unit corresponds to Miller’s (1956) “chunking” account of memory capacity. Miller defines the capacity of short-term memory as a rather fixed or limited storage place, which accommodates seven (plus or minus two) “chunks” of information. A “chunk” refers to a group of data arranged together based on the previously learned patterns which convert the sound stream of the language into meaningful units. For example, the words, “the beautiful girls are singing and dancing in front of many people” will be chunked into a few units like this: (the beautiful girls) (are singing and dancing) (in front of many people) (as quoted in Call, 1979). This example of “chunking”, thus, clearly suggests that the more information a listener can pack into a chunk, the more information he/she can store for further semantic analysis (Ellis, 1996).

In other words, each unit can usually be defined syntactically as a word, a phrase, or a clause. The syntactic units, then, go through the process of semantic interpretation before they are purged from short-term memory in order to make room for new incoming data. Although the semantic information may pass into long-term memory, the exact wordings in which the original messages were expressed are often lost or forgotten once the meaning has been extracted (Jarvella, 1971). Thus, short-term memory plays a central role not only in providing a space for language processing but also making a decision over whether the extracted meaning can pass into long-term memory storage for further retention (Call, 1985).

What are the relationships between short-term memory (STM) and L2 learning?

To date, there has been not much research in the field of SLA that specifically investigates the role of short-term memory in L2 learning and comprehension processes (Cook, 1991). One of the earlier studies by Glicksberg (1963), which was designed to investigate the relationship between short-term memory span and language proficiency, found that the span of short-term memory is reduced in a second language. He administered memory tests on a group of ESL students and compared the scores with their standardized listening comprehension test scores. The results did not show a strong

correlation between their scores on the random digit memory test and listening comprehension scores, but the study also found that the L2 memory span for random digits improved from 6.4 digits at the beginning of the research period up to 6.7 at the end. Although the digit spans of the students were still below those of native English speakers, who scored 7.1 digits, these findings clearly indicate that short-term memory span and L2 listening comprehension are related in a positive way. However, the low correlation attained between the short-term memory span for random digits and L2 listening comprehension scores also suggests that short-term memory for random digits might not be a single most influential factor that determines successful L2 listening comprehension.

In order to account for this result, Cook (1985) proposed that there might be two different aspects of memory, which he calls “primary memory” and “speech-processing memory”. Primary memory is said to serve for memory tasks not highly dependent on language and therefore is considered to be quite transferable from the L1 to the L2. Speech-processing memory, on the other hand, is highly dependent on language, and thus its capacity available for adult learners is limited, according to the level of facility that those learners possess in using the syntactic knowledge in the L2.

A similar study by Loe (1964), which investigated L2 memory span for lengthy and grammatically complex sentences, found that longer sentences were more difficult to recall than shorter ones, and also that there were considerable qualitative differences in the ways of recalling grammatically complex sentences between proficient students (including native speakers and advanced students) and less-proficient students. That is, proficient students recalled sentences that contained clauses better than sentences composed of a series of phrases of the same length, whereas less proficient students found the sentences made up of phrases much easier to recall. These results suggest that 1) the amount of L2 input that can be successfully processed seems to increase as the level of L2 proficiency increases, and that 2) knowledge of L2 syntax patterns seems to play an important role in grouping incoming linguistic data efficiently, as it consequently increases the amount of L2 input that learners can retain in short-term memory.

More recent studies concerning the role of short-term memory in language learning have concentrated on how short-term memory works for the processing of linguistic input rather than on its length (Call, 1985). Several studies by Cook (1975, 1985) have provided some interesting findings on short-term memory and its relationship with L2 learning. He examined the ability of adult L2 learners to process spoken English sentences. Half of the sentences contained single embedded relative clauses: The cat that likes the dogs bites the horse., and the other half had double embedded relative clauses: The cat that likes the dog that sees the man bites the horse (as quoted in Call, 1979). The participants of the study were asked to find the subject and the object of the verb “bite”. By comparing the performance of the adult L2 learners of English with adult native speakers of English and also with native children (4 to 9 years old), Cook (1975) found that adult L2 learners and native children had more difficulty interpreting single embedded clauses than did native adults, but that double embedded relative clauses were equally difficult for all groups. He analyzed such results by claiming that the adult L2 learners and native children may have had to rely heavily on the actor-action-object processing strategy suggested by Bever (1970). According to Bever (1970), the actor-action-object strategy refers to one of the processing strategies in which a sequence of known-verb-noun will be interpreted as the subject, verb, and object of the sentence.

In other words, the speech processing ability of the adult L2 learners may be parallel to that of native children, in the sense that the processing system of both groups were overloaded by the single embeddings.

These findings, thus, suggest that just as the language processing capabilities of children expand as they grow older, adult L2 learners' ability to process more complex L2 structures will increase as their capacity for language processing expands.

Implications for L2 Learning and Teaching

From the previous discussions on the mechanism of short-term memory and its relationship with L2 comprehension processes, several generalizations can be drawn, so that we can gain some insights into teaching L2 listening comprehension skills.

- 1) Short-term memory capacity for L2 input is smaller than for L1 input (Glicksberg, 1963; Cook 1977, 1985)
- 2) The amount of L2 input that can be successfully processed for comprehension seems to increase as L2 proficiency level increases (Glicksberg, 1963; Cook, 1975).
- 3) Syntactic complexity of L2 linguistic input influences the amount of linguistic material that can be retained in short-term memory (Cook, 1975), as well as the likelihood of recall (Loe, 1964).
- 4) Short-term memory span for random digits seems to be only marginally correlated with overall L2 proficiency, which suggests that L2 learning success cannot be determined or predicted based only on the random digits scores.
- 5) In relation to (4), two aspects of short-term memory have been identified (Cook, 1975; Baddeley, 1986): primary memory and speech processing memory (Cook, 1975) or working memory (Baddeley, 1986).

According to Cook (1975) and Baddeley (1986), L2 speech processing memory, or L2 working memory, is limited in capacity depending on the learner's facility in using L2 syntax. In other words, syntactic short-term memory functions basically in the same way in L2 as it does in L1, even though its capacity can vary depending on the learner's different L2 syntactic knowledge. On the other hand, however, L2 primary memory span, which does not depend on language, can be transferred fairly intact from L1. Such insights into the nature of L2 syntactic memory, thus, clearly suggest that learners can benefit more from L2 syntactic exercises or some learning activities that focus on L2 structures (Call, 1985).

It should be noted, however, that this line of interpretation does not necessarily imply that L2 syntactic knowledge could directly contribute to the development of L2 listening comprehension skills, but rather that knowledge of L2 syntactic structures could help facilitate the "top-down processing" of the incoming linguistic data.

In light of the fact that L2 short-term memory is often overloaded with inefficient processing mechanism due to the heavy reliance on the "bottom-up processing", ESL/EFL teachers should be more aware of the processing difficulty that their students have in L2 listening comprehension tasks. It is such awareness of the teachers that could be the first step for providing further effective listening activities in the classroom. As Call (1979) clearly notes, the listening comprehension difficulty experienced by many L2 learners can be amended through some of the listening strategy instruction, so that the teacher can help the students use their short-term memory capacity more efficiently. Based on her research, Call (1979) further suggests the effectiveness of strategy training for improving L2 comprehension skills, by saying that "learners may well progress more effectively if they know how to

chunk the incoming linguistic data before they are asked to respond to the significance of the utterance” (p. 65).

Although there may exist many more ways that we can help our students deal with listening comprehension tasks more efficiently, the important thing that we should always keep in mind is that L2 learners are facing highly complex and mentally challenging tasks, while they are engaged in listening comprehension activities.

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